

UNITED STATES PATENT APPLICATION

for

MULTI-SIDED DISPLAY FOR PORTABLE COMPUTER

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PALM-3304/ACM/AMT

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5 FIELD OF THE INVENTION

10 a portable computer system.

BACKGROUND OF THE INVENTION

20 planners, electronic schedulers and the like.

25 pocket. By virtue of its size, the palmtop computer, being inherently lightweight,

SECRET

These and other objects and advantages of the present invention will no doubt become obvious to those of ordinary skill in the art after having read the following detailed description of the preferred embodiments which are illustrated in the various drawing figures.

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of the display panels by the opening of the front cover of the portable computer system.

In one embodiment, the present invention is comprised of a front cover.

5 The front cover is electrically and mechanically coupled to the palmtop computer.

In the present embodiment, a first display component is coupled to the front cover. The first display component further comprises a front display panel and a rear display panel. In the present embodiment, a second display component is mounted with the portable computer system. In another embodiment, a third

display component may be provided and coupled to the portable computer system. Additionally, in one embodiment, the technology used in the display component is electric ink display. Further, in the present embodiment, the

display component is flexible. Furthermore, in the present invention, a display control circuit is included in the portable computer system. The display control

15 circuit is adapted to activate the first display component and the second display

component. The display control circuit is further adapted to activate the third display component, provided the third display component is present and coupled to the portable computer. The display control circuit is further adapted to provide that activation in direct response to the orientation of the front cover.

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accordance with one embodiment of the present invention.

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FIGURE 11 is a front facing illustrated perspective view of the portable computer system of Figure 10 with the front cover opened, exposing the second of three display components, in accordance with one embodiment of the present invention.

FIGURE 12 is a front facing illustrated perspective view of the portable computer system of Figure 10 with the front and second covers opened, exposing three display panels, in accordance with one embodiment of the present invention.

FIGURE 13 is a block diagram of the palmtop computer in Figures 8 and 9, in accordance with one embodiment of the present invention.

FIGURE 14 is a cross section illustrated perspective view of a display panel of the present invention in accordance with one embodiment of the present invention.

FIGURE 15 is a cross section illustrated perspective view of a display panel of the present invention in accordance with one embodiment of the present invention.

FIGURE 16 is a cross section illustrated perspective view of a display panel of the present invention in accordance with one embodiment of the present invention.

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for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like.

It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussions, it is appreciated that throughout the present invention, discussions utilizing terms such as "activating" or "determining" or "indicating" or "indexing" or "receiving" or "performing" or "initiating" or "sending" or "implementing" or "disabling" or "enabling" or "displaying" or the like, refer to the action and processes of a computer system or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

Embodiments of the present invention are discussed primarily in the context of a portable computer system, such as a palmtop or personal digital assistant. However, it is appreciated that the present invention can be used with other types of devices that utilize a flat panel display device, including but not limited to palmtop computer systems, pagers, cell phones, remote web browsers, remote control devices, etc.

EXEMPLARY PALMTOP PLATFORM

Figure 1A is a block diagram of an exemplary network environment 50 including a portable computer system 100 in accordance with one embodiment of the present invention. Portable computer system 100 is also known as a palmtop or palm-sized computer system. In one embodiment, portable computer system 100 has the ability to transmit and receive data and information over a wireless communication interface (e.g., a radio interface). For purposes of the present application, the term "portable computer system" is not intended to be limited solely to conventional palmtop or portable computers. Instead, the term "portable computer" or "portable computer system" is also intended to include any mobile electronic device. Such mobile devices include but are not limited to pagers and paging systems, wireless and cellular telephones, electronic address books, and numerous other mobile devices which may have the ability to wirelessly communicate with a network. As such, for purposes of the present application, the terms "portable computer" and "mobile device" will be considered synonymous and will be used interchangeably.

Base station 32 can be both a transmitter and receiver base station, which can be implemented by coupling it into an existing public telephone network 34. Implemented in this manner, base station 32 enables portable computer system 100 to communicate with a proxy server computer system 36, which is coupled by wire to the existing public telephone network 34. Furthermore, proxy server computer system 36 is coupled to the Internet 52, thereby enabling portable

system. Furthermore, any wireless network, in addition to the Mobitex wireless network, can support the functionality to be disclosed herein.

Figure 1B illustrates another embodiment of a system 51 that can be used in conjunction with various embodiments of the present invention. System 51 comprises a host computer system 56 which can either be a desktop unit as shown, or, alternatively, can be a laptop system 58. Optionally, one or more host computer systems can be used within system 51. Host computer systems 58 and 56 are shown connected to a communication bus 54, which in one embodiment can be a serial communication bus, but could be of any of a number of well known designs, e.g., a parallel bus, Ethernet Local Area Network (LAN), etc. Optionally, bus 54 can provide communication with the Internet 52 using a number of well-known protocols.

Importantly, bus 54 is also coupled to a cradle 60 for receiving and initiating communication with portable computer system 100. Cradle 60 provides an electrical and mechanical communication interface between bus 54 (and anything coupled to bus 54) and the computer system 100 for two-way communications. Portable computer system 100 may instead be coupled to host computer systems 56 and 58 via a wireless (radio) connection. Computer system 100 also contains a wireless infrared communication mechanism 64 for sending and receiving information from other devices. Additionally, in Figure 1B, the existing telephone network could also be a packet-based network, as is the Bellsouth wireless data network utilized by some conventional portable computer systems.

secure data cards, and the like. Portable computer 100 of Figure 6 is otherwise analogous to portable computer 100 of Figure 5.

Figure 7 illustrates circuitry of computer system 100, some of which can
5 be implemented on PC board 225 (Figure 4). Computer system 100 includes an
address/data bus 110 for communicating information, a central processor 101
coupled with the bus for processing information and instructions, a volatile
memory 102 (e.g., random access memory, RAM) coupled with the bus 110 for
storing information and instructions for the central processor 101 and a non-
10 volatile memory 103 (e.g., read only memory, ROM) coupled with the bus 110 for
storing static information and instructions for the processor 101. Computer
system 100 also includes an optional data storage device 104 (e.g., memory
stick) coupled with the bus 110 for storing information and instructions. Device
104 can be removable. As described above, computer system 100 also contains
15 a display device 105 coupled to the bus 110 for displaying information to the
computer user. PC board 225 can contain the processor 101, the bus 110, the
ROM 103 and the RAM 102.

With reference still to Figure 7, computer system 100 also includes a
20 signal transmitter/receiver device 108, which is coupled to bus 110 for providing
a physical communication link between computer system 100, and a network
environment (e.g., network environments 50 and 51 of Figures 1A and 1B,
respectively). As such, signal transmitter/receiver device 108 enables central
processor unit 101 to communicate wirelessly with other electronic systems
25 coupled to the network. It should be appreciated that within the present

graphic images and alphanumeric characters recognizable to the user. In the preferred embodiment, display device 105 is a flat panel display.

MULTI-DISPLAY EMBODIMENT

With reference to Figure 8, portable computer system 100 is shown in a front facing illustrated perspective view with the front cover closed. This embodiment provides a display component as the cover and this display component has a front display panel and a rear display panel. In this embodiment, flat panel display technology is used. On/off button 95 is shown as being disposed on the top surface area of portable computer 100 and oriented on the right side. Region 550, shown as disposed toward the bottom of front cover 300, is adapted to provide access to dedicated and/or programmable buttons 75. In one embodiment of the present invention, when front display panel 500A is activated through the pressing of on/off button 95, the information displayed may need to be manipulated, and therefore access to buttons 75 is most advantageous. Front display panel 500A is shown as disposed integral with hinged front cover 300. Front cover 300 may rotate, as shown by the arrow, about the axis. A display control circuit 200 (Figure 13) is included in portable computer 100 integral with the electronic circuitry within the portable computer, and is adapted to control the activation of the display panels, as described in more detail herein.

Referring to Figure 8, when a user turns on/powers up palmtop computer 100, display control circuit 200 determines the orientation of front cover 300. If display control circuit 200 (Figure 13) determines that front cover 300 is in the

closed (default) position, it activates front display panel 500A such that information or data becomes viewable. In the example shown, the data viewed is a monthly calendar, e.g., the month of September, as shown in Figure 8. It should be appreciated that the data could be any data, e.g., a GUI (graphical user interface) or other information presented in a fashion associated with single panel displays.

Referring now to Figure 9, the portable computer 100 of Figure 8 is shown as having front cover 300 in the open (non-default) position. Rear display panel 500B, on the left, is now visible. Rear panel display 500B is the other display panel contained within front cover 300, and is functionally analogous to front display panel 500A. Display screen 600 is shown on the right, coupled to palmtop computer 100, and is also functionally analogous to either display panel 500A or 500B.

Still referring to Figure 9, by virtue of the orientation of front cover 300, display control circuit 200 automatically deactivates originally activated front display panel 500A, and activates rear panel 500B of front cover 300.

Additionally, display control circuitry 200 activates now visible display screen

600. When front cover 500A is deactivated, the data or information previously viewable, e.g., the month of September as shown in Figure 8, is reoriented so as to be identically viewable on rear display panel 500B, as shown in Figure 9.

Additionally, display screen 600 is activated thereby providing another viewable panel on which new data or information may be displayed. In the current

example, the information is a monthly calendar, e.g., the month of October, and it

shown on the right of Figure 9. Of course, the user may display any information on either of the multiple display panels.

It should be appreciated that by providing a second display panel to the functionality of a portable computer system, the amount of viewable surface area has been effectively doubled, therefore providing increased functionality to the portable computer system. For example, a user may display a calendar on one panel, and notes regarding the calendar on the other. In another example, a user may display a schedule on one panel and information regarding the calendar on the other. In yet another example, a user may display the GUI (graphical user interface) on one panel, and have the selected icon's associated application appear on the other screen, reducing the time required to switch back and forth from the GUI to associated applications as is customary when using a conventional portable computer system. In fact, a two-sided display, as one embodiment of the present invention, provides an almost endless array of functional configurations.

Figures 10, 11, and 12 are front facing illustrated perspective views of portable computer 100 configured with three display panels, in accordance with another embodiment of the present invention. With reference to Figure 10, portable computer system 100 has two flip covers and is shown in a front facing illustrated perspective view, one embodiment of the present invention. The example of Figure 10 illustrates front cover 300 closed. Front cover 300 is a display component having a front display panel and a rear display panel. Region 550, shown as disposed toward the bottom of front cover 300, is adapted to

functionally analogous to front panel display 500A. Front display panel 600A, on the right, is disposed on the now visible second cover 301. Front display panel 600A is also functionally analogous to front display panel 500A.

5 Referring to Figure 11, by virtue of the orientation of front cover 300, display control circuit 200 automatically deactivates originally activated front display panel 500A, and activates rear panel 500B of front cover 300. Additionally, display control circuitry 200 automatically activates now visible front display panel 600A of second cover 301. When front panel display 500A of front
10 cover 300 is deactivated, the data or information previously viewable, e.g., the month of September as shown in Figure 10, is reoriented so as to be identically viewable on rear display panel 500B, as shown in Figure 11. Additionally, front display panel 600A is activated thereby providing another new viewable panel on which data or information may be displayed. In the current example, the
15 information is a monthly calendar, e.g., the month of October, and is shown as viewable on rear display panel 600B of Figure 11.

Now referring to Figure 12, the portable computer system 100 of Figures 10 and 11 is now shown with three display panels visible. Front cover 300 is
20 shown in the open position, which therefore has activated visible display panel 500B. Second cover 301 is also shown as being in the open (non-default) position. By opening second cover 301, the previously visible front display panel 600A is deactivated, and the now visible display panel 600B is activated by display control circuit 200. Further activated by display control circuit 200 is

display screen 700, which can be mounted in palmtop computer 100, and functionally analogous to display screen 600 in Figure 9.

Referring to Figure 12, when rear display panel 600B and display screen 700 are activated, the information or data viewable in the deactivated front display panel 600A of Figure 11 is reoriented so as to be identically viewable on a visible display panel. For instance, the information contained in front display panel 600A was a monthly calendar, e.g., the month of October, as shown in Figure 11. Instructions provided enable display control circuit 200 to reorient October to be viewable in display screen 700. Additionally, rear display panel 600B is activated thereby providing another viewable panel on which data or information may be displayed. In the current example, the information is a monthly calendar, e.g., the month of November, and is shown as viewable on rear display panel 600B of Figure 12.

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It should be appreciated that in another example of the present invention, the data or information being displayed, as previously described, may or may not require the exemplary configuration as shown in Figures 8 and 9, or in Figures 10, 11, and 12. It should be further appreciated that configuration of the data or information displayed is generally defined by the user or by the application with which the user is interacting.

It should be appreciated that while the portable computer 100 of Figures 8 and 9 is shown as having two distinct display panels, it can be configured analogous to the depicted portable computer 100 of Figure 10, 11, and 12,

which is shown to have three panels seamlessly connected. This is enabled by the virtue of the thinness, strength, and flexibility of the material used to construct the two-sided display. It should be conversely appreciated that while the palmtop computer 100 of Figures 10, 11, and 12 is shown as a seamless panel, it can be adapted to have three distinct display panels.

Including three display panels in palmtop computer 100 enables a user to now see much more information, e.g., a user can view complete spreadsheets without having to switch back and forth from one section to another. In one example, a user would be able to view a graphic e.g., elongated pictures, wide diagrams, complex and expansive formulas, and the like, in their entirety, no longer having to scroll or switch from one section or screen to another. In another example, a user may wish to have multiple daily schedules, or multiple weekly, monthly, or yearly calendars displayed, thereby reducing the switching of screens normally associated with portable computers not configured with the present invention. In yet another example, a user may wish to view multiple financial documents, e.g., annual income statements from various years. In yet another example, a user may wish to view multiple web pages. In still another example, and by utilizing the networking functionalities contained within the portable computer, a user connected and communicating with other individuals via a network, could have information from other portable computers displayed on one or more panels and compared with or integrated into information contained within the other panels. A virtually endless array of viewing configurations and functionalities are now available to a user.

electrostatically charged, making them reactive to a more positive voltage, so as to be drawn to the more positive voltage. In one embodiment of the present invention, encapsulated ink droplets 1540 are black in color.

5 Referring to Figure 14, transparent conductor 1510A, associated with display panel 500A, is adapted to conduct voltage such that when a more positive voltage is present, through an activation provided by display control circuit 200, electrostatically charged and encapsulated, in one embodiment, black ink droplets 1540 are drawn to transparent conductor 1510A, thereby displacing
10 ink fluid 1530, and forming into shapes that take the form of graphics or letters. By virtue of the white ink fluid 1530 contrasting with the black ink droplets 1540, a virtual printed paper is displayed through transparent material 1520. It should be appreciated that transparent conductor 1510B, associated with display panel 500B, is analogous in form and function to transparent conductor 1510A,
15 associated with display panel 500A. In one embodiment, transparent conductors 1510A and 1510B are indium tin oxide.

Figure 14 is a depiction of the display panel in a non powered state, and as such, a more positive voltage is not being applied to either transparent conductor 1510A or 1510B. Therefore, in one embodiment of the present invention, electrostatically charged encapsulated ink droplets 1540 are free floating and are randomly floating about within sealed chamber 1500 and are thusly depicted in Figure 14.

Figure 15 is a cross-section illustrated perspective of the display panel when in the default state, analogous to portable computer 100 of Figure 8, one embodiment of the present invention. When power is applied to portable computer 100 with front cover 300 in the closed or default position, display control circuit 200 automatically activates transparent conductors 1510A, such that it has a more positive voltage. This is shown as positive (+) signs within depicted transparent conductor 1510A and as negative (-) signs within depicted transparent conductor 1510B. Accordingly, this attracts electrostatically charged encapsulated ink droplets 1540 to transparent conductors 1510A associated with display panel 500A. Ink droplets 1540, by virtue of the voltage applied, displace ink fluid 1530, and form letters or graphics viewable from display panel 500A. In one embodiment of the present invention, the ink droplets 1540 take the form of information, e.g., a monthly calendar, e.g., the month of September, as shown in Figure 8.

Figure 16 is a cross-section illustrated perspective of the display panel when front cover 300 is in the open position, analogous to portable computer 100 of Figure 9. When power has been applied to portable computer 100, such that it is turned on, and a user subsequently opens front cover 300, display control circuit 200 deactivates transparent conductor 1510A. Simultaneously, display control circuit 200 activates transparent conductor 1510B, such that it has a more positive voltage. This is shown as positive (+) signs within depicted transparent conductors 1510B and negative (-) signs within transparent conductors 1510A. Accordingly, this attracts electrostatically charged encapsulated ink droplets 1540 to transparent conductors 1510B associated with display panel 500B. Ink droplets 1540, by virtue of the voltage applied, displace ink fluid 1530, and form

letters or graphics viewable from display panel 500B. In one embodiment of the present invention, the ink droplets 1540 take the form of a monthly calendar, e.g., the month of September, as shown in Figure 9.

5 Referring to Figure 16, it should be appreciated that subsequent to the opening of front cover 300, the image viewable in display panel 500A, which in one embodiment is a monthly calendar, e.g., the month of September, display control circuit 200 deactivates the viewable image in panel 500A, and activates panel 500B, thereby reorienting the September calendar, such that it is now
10 viewable in panel 500B. This embodiment of the present invention is depicted in Figure 9. It should be further appreciated that when display control circuit 200 activated display panel 500B, it also activated display screen 600 coupled to portable computer, such that in one embodiment it could be a monthly calendar, e.g., the month of October, also shown in Figure 9.

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It should be appreciated that many of encapsulated ink droplets are contained within the sealed chamber of a two-sided display panel. It should further be appreciated that each two-sided display panel is approximately 1 mm thick, about one seventh the thickness of an LCD. It should also be appreciated that the
20 transparent conductors are configured in numerous grids, such that the text or graphics displayed in a display panel has the appearance of printed paper. It is even further appreciated that the viewable image on the display is visually persistent, meaning that until an additional display panel is activated, in one embodiment of the present invention, or the information/data being displayed is

changed, the contents and quality of the display remains constant without using power.

Additionally, it should be appreciated that while the present invention is discussed primarily in the context of having two colors, those colors being black and white, other colors may be used, either as a replacement color for either black or white, but also as an additional color within the sealed chamber. Further, while a more positive voltage applied to transparent conductors attracts the encapsulated ink droplets, colored ink droplets may be responsive to varying amount of voltage conducted through the transparent conductor. In the present embodiment of the present invention, when the transparent conductor associated with one of the display panels has a voltage more positive than that of the opposite side, the encapsulated ink droplets are attracted to the more positive side.

15 In another embodiment of the present invention, each additional color, as an encapsulated ink droplet, could be electrostatically charged so as to make it responsive to a specific voltage. In one embodiment, red colored ink droplets could be configured to be responsive to 4.35 micro-volts. In one embodiment, green colored ink droplets could be configured to be responsive to 4.30 micro-volts. In one embodiment, blue colored ink droplets could be configured to be responsive to 4.40 micro-volts, and so forth. It should be appreciated that while micro-volts may be utilized to attract the colored ink droplets, other types of electrical energy could also be implemented.

25 With reference to Figure 17, a flow chart depicting the steps of a process 1700 utilizing the portable computer 100 in Figures 8 and 9 is shown, in accordance with one embodiment of the present invention.

- In step 1807, it should be appreciated that the information or data originally viewable on front display panel 500A, which in one embodiment is a monthly calendar, e.g., the month of September, was reoriented by display control circuit 200 and enabled to be viewable on rear display panel 500B. It should be further appreciated that the information or data originally viewable on front display panel 600A, which in one embodiment is a monthly calendar, e.g., the month of October, was reoriented by display control circuit 200 and enabled to be viewable on display screen 700. It should be additionally appreciated that display control circuit 200 activated rear display panel 600B to viewably display additional information or data, which in one example is a monthly calendar, e.g., the month of November. This current embodiment of the present invention is depicted in Figure 12.
- The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the Claims appended hereto and their equivalents.